(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 270 122**
A3

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **87117920.6**

(51) Int. Cl.4: **G01L 3/10**

(22) Date of filing: **03.12.87**

(30) Priority: **05.12.86 US 938404**
17.11.87 US 119531

(43) Date of publication of application:
08.06.88 Bulletin 88/23

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

(88) Date of deferred publication of the search report:
22.03.89 Bulletin 89/12

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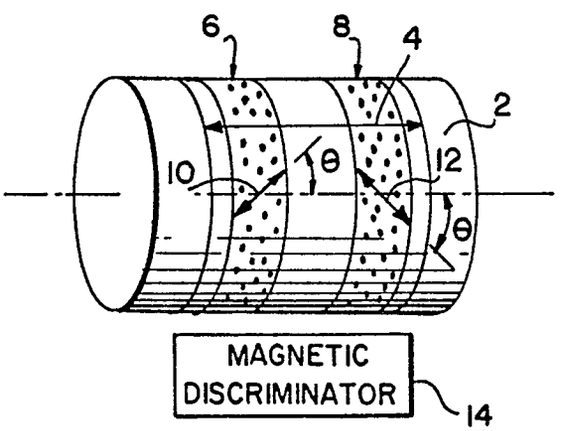
(54) Magnetoelastic torque transducer.

(57) A magnetoelastic torque transducer for providing an electrical signal indicative of the torque applied to a member, the member including ferromagnetic, magnetostrictive means affixed to, associated with or forming a part of the surface of the torqued member for altering in magnetic permeability in response to the application of torque to the member. The ferromagnetic, magnetostrictive means is advantageously formed of a thermally hardened or iron-nickel martensite hardenable steel alloy characterized by a substantially isotropic magnetostriction having an absolute value of at least 5 ppm and including from 0.05 to 0.75 percent by weight carbon and sufficient of one or more elements selected from Ni, Cr, Co, Ti, Al, Mn, Mo, Cu and B to raise the alloy magnetostriction to at least 5 ppm absolute. Preferably, the ferromagnetic, magnetostrictive means is formed of nickel maraging steel. The transducer comprises a pair of axially spaced-apart annular bands defined within a region of the ferromagnetic, magnetostrictive means, the bands being endowed with residual stress created, respectively symmetrical right and left hand helically directed magnetic anisotropy of sufficiently large magnitude that the contribution to total magnetic anisotropy of any random anisotropy in the member is negligible. In one aspect of the invention, each said band has at least one circumferential region which is free of residually unstressed areas over at least 50% of its circumferential length. In another aspect of the invention, the alloy is thermally hardened before the bands are endowed with the residual stress-created magnetic anisotropy.

FIG. 1.



EP 0 270 122 A3

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EP 87 11 7920

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
P,X	DE-A-3 704 049 (NISSAN MOTOR CO. LTD.) * abstract; claims 1-5,7,12-16; column 4, line 29 - column 5, line 34; column 12, line 28 - column 13, line 38; column 15, line 57 - column 16, line 12; figures 4,8,22,24 *	1-5,11-14,18	G 01 L 3/10
P,Y		6-10,16,19-21,25	
Y	GB-A-2 140 565 (ASEA AKTIEBOLAG) * abstract; claims 1-4,6,9-11; page 1, lines 30-61; page 1, line 109 - page 2, line 35; figures 1B,2B,3 *	1-10	
Y	US-A-4 236 230 (D.A. THOMPSON) * abstract; claims 1,6,8,13; column 3, line 58 - column 4, line 29; figures 2,3 *	1-10,16	
Y	IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY volume VT-31, no. 3, August 1982, New York, USA, pages 117-124; W.J. FLEMING: "Automotive torque measurement: A summary of seven differnt methods" * page 117, right hand column, paragraph 3 - page 118, right hand column, last paragraph; figure 2 *	19,20	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
Y	DE-B-2 654 863 (MOTOREN- UND TURBINEN UNION) * claims 1-4; figures 1-3 *	21	C 21 D C 21 D C 22 C G 01 C G 01 L G 01 L H 01 L

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	28-12-1988	VORROPOULOS G

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	EP-A-0 133 126 (REGIE NATIONALE DES USINES RENAULT) * abstract; page 2, lines 16-34; claims 1-4; figure 1 *	25	
A	EP-A-0 107 082 (TOKYO SHIBAURA DENKI KABUSHIKI KAISHA) * abstract; page 13, table; claims 1-12; figures 1,2 *	1,11	
A	NACHSCHLAGEWERK STAHLSCHLÜSSEL 6th edition, April 1962, Verlag Stahlschlüssel Marbach; A. ALBRECHT * page 42 *	1,11-13	
A	DE-A-2 939 620 (ZAHNRADFABRIK FRIEDRICHSHAFEN AG) * claims 1-6; page 7, paragraph 2 - page 9, paragraph 1; figures 2,3 *	1-10	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)

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